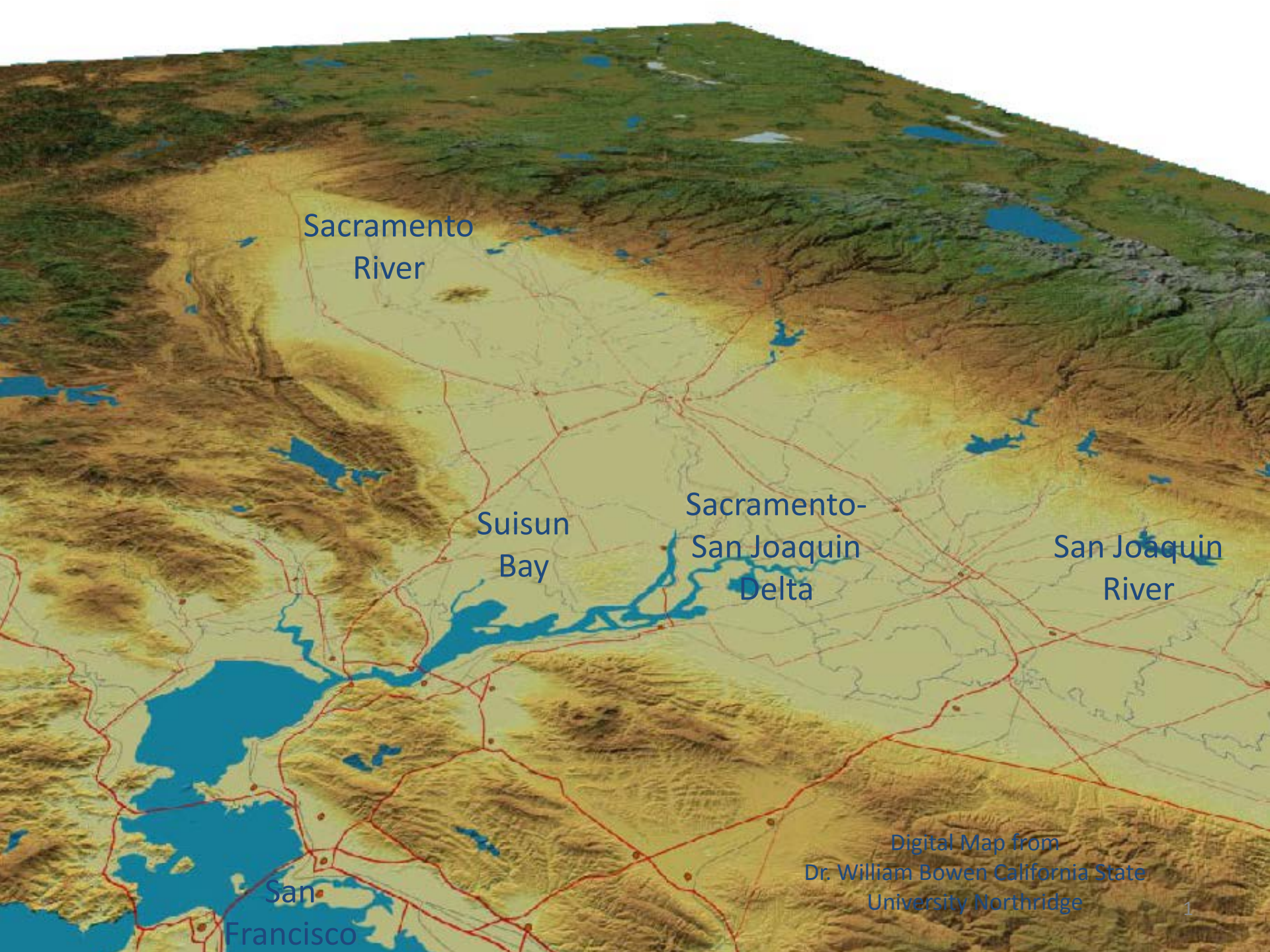
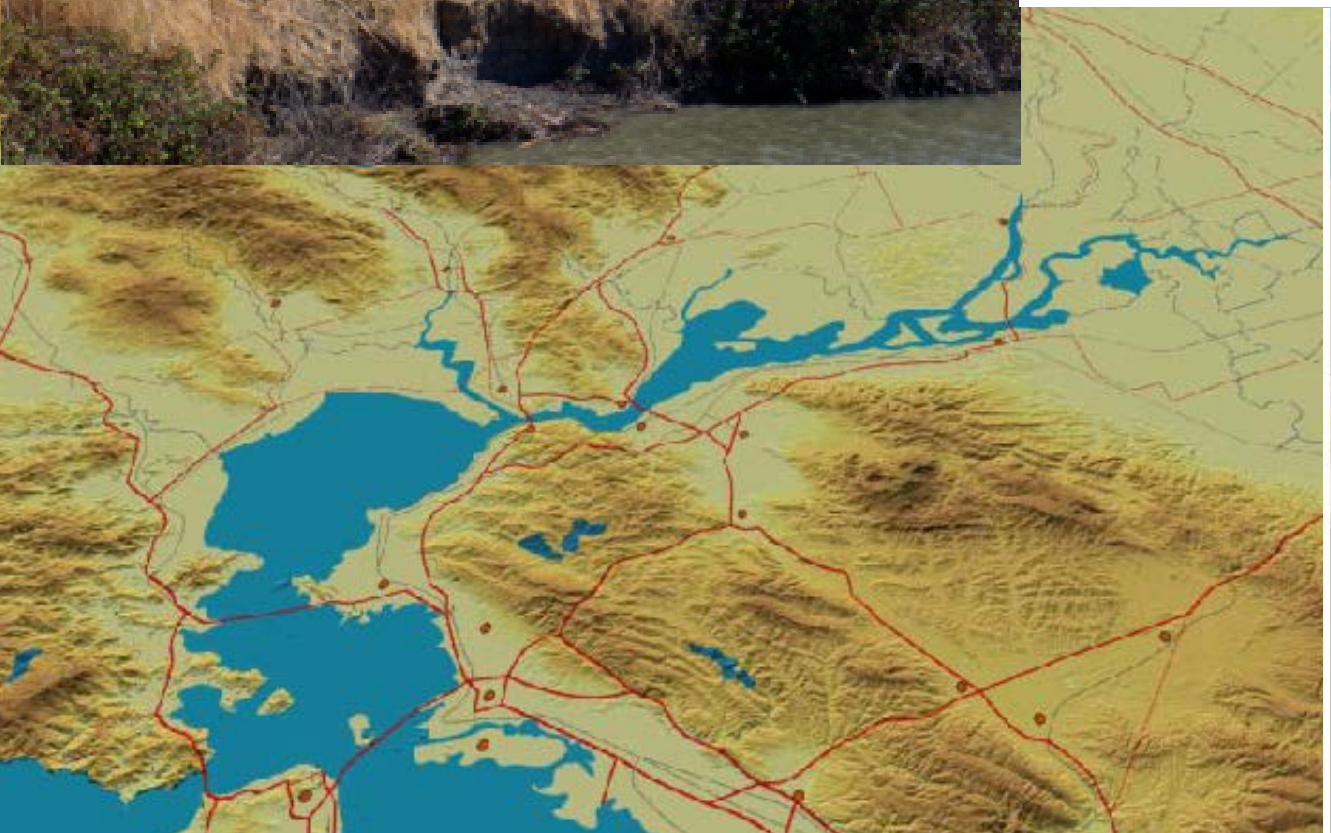


Digital Map from
Dr. William Bowen California State University Northridge



Head of Old River Barrier

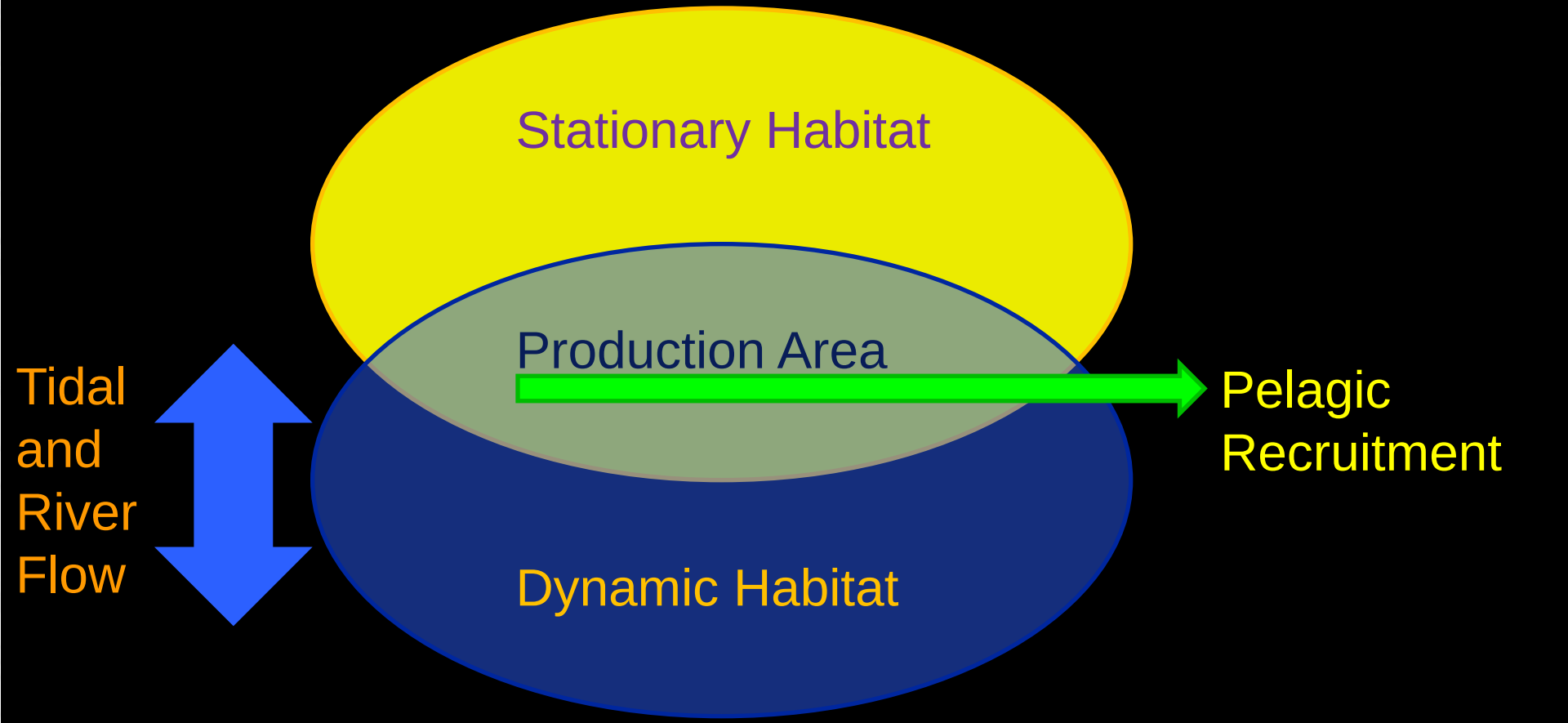
Stationary Habitat ---Geometry

Dynamic Habitat ---
Hydrodynamics, ocean conditions, weather

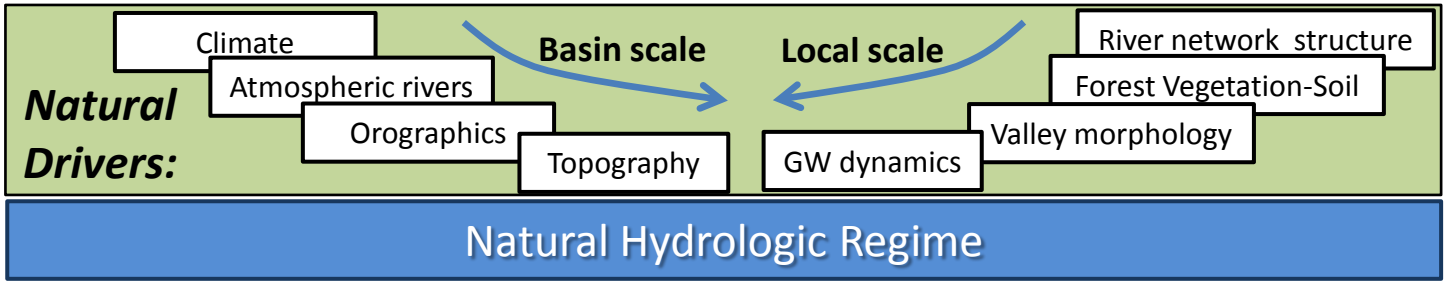
Biological Conditions

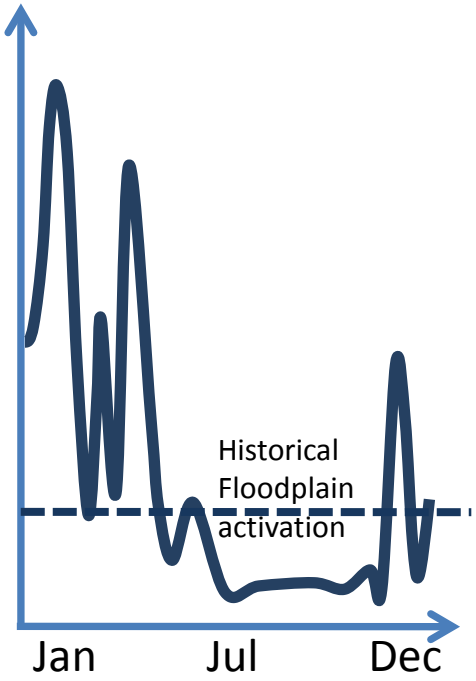
Environment

Estuarine habitat conceptual model
(Peterson 2003)

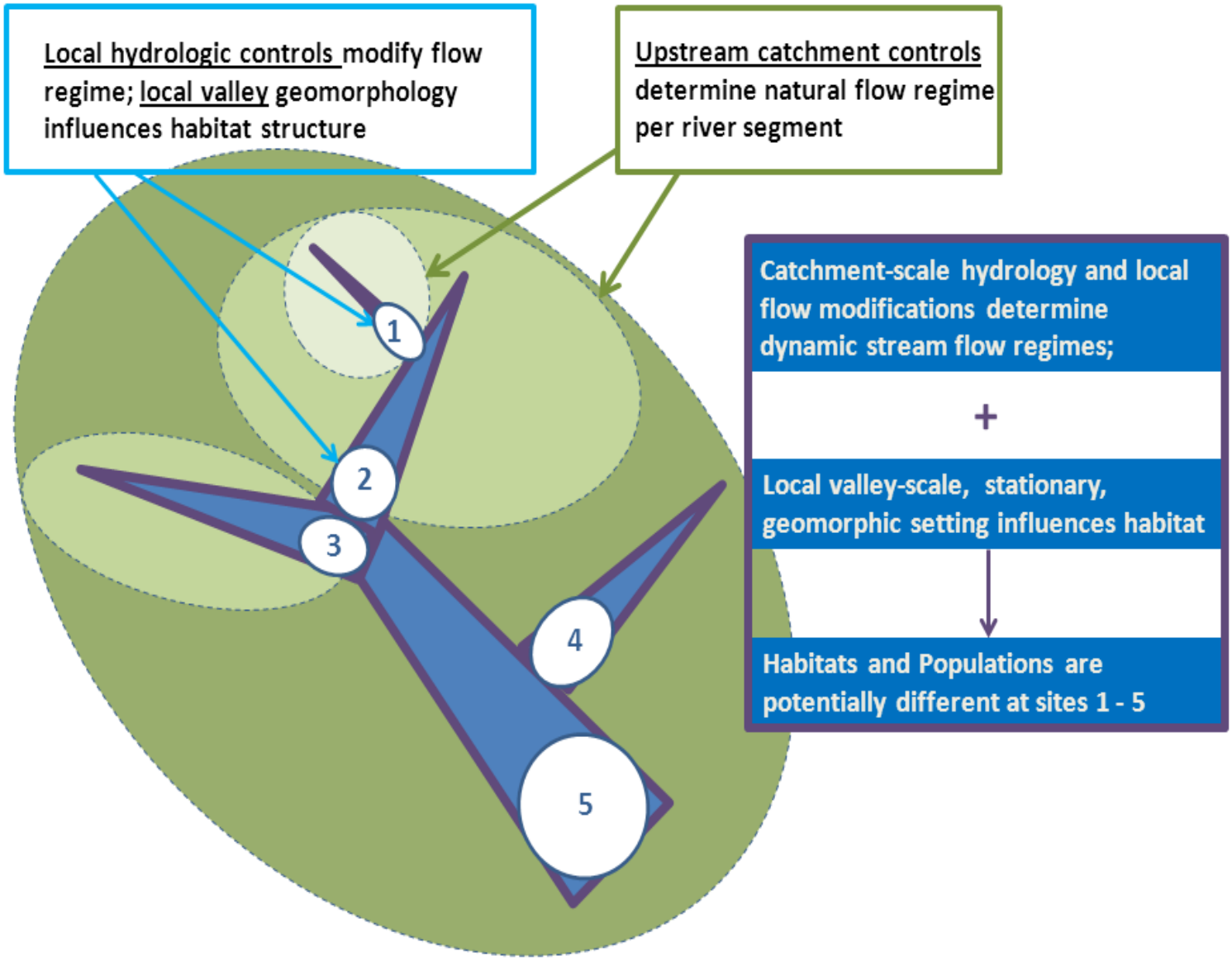


Cascade of responses to altered flow

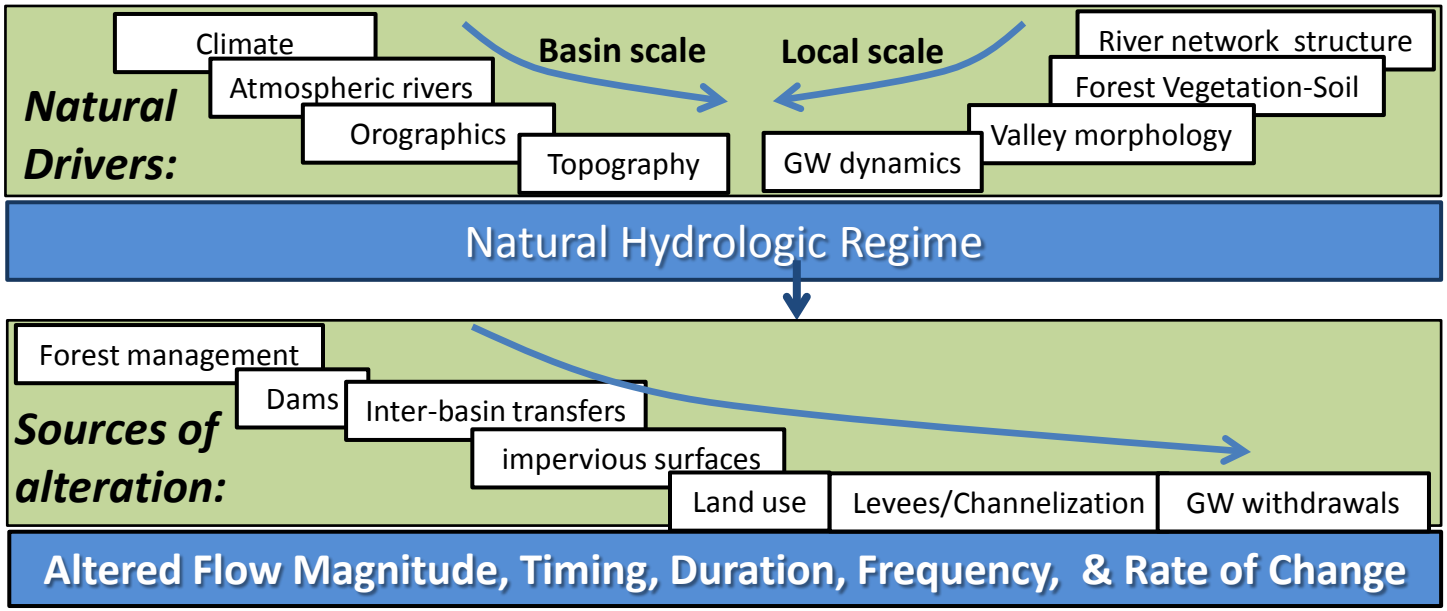


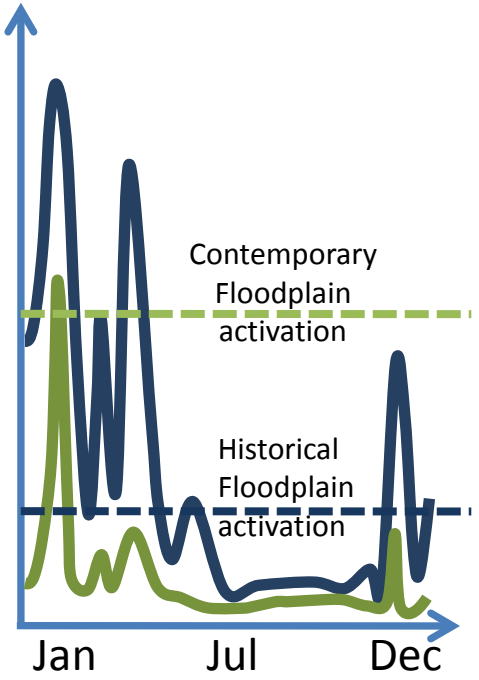


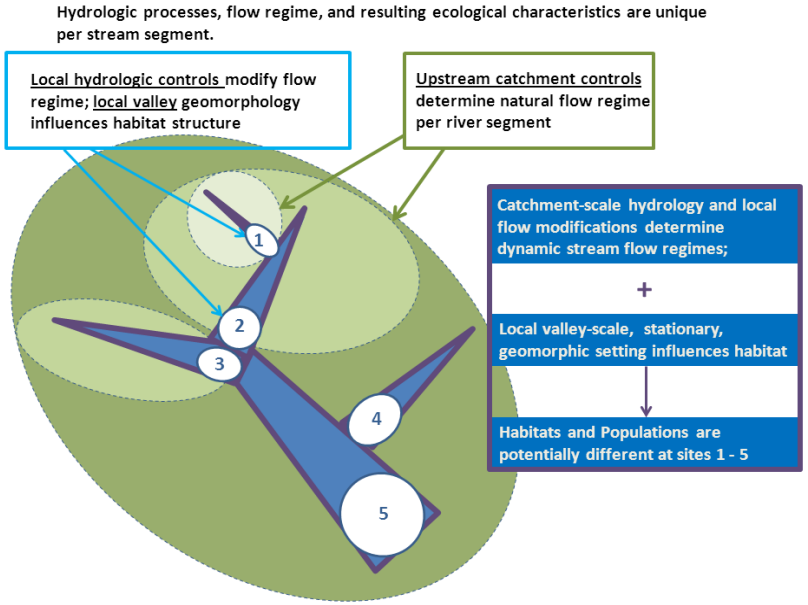
Hydrologic processes, flow regime, and resulting ecological characteristics are unique per stream segment.



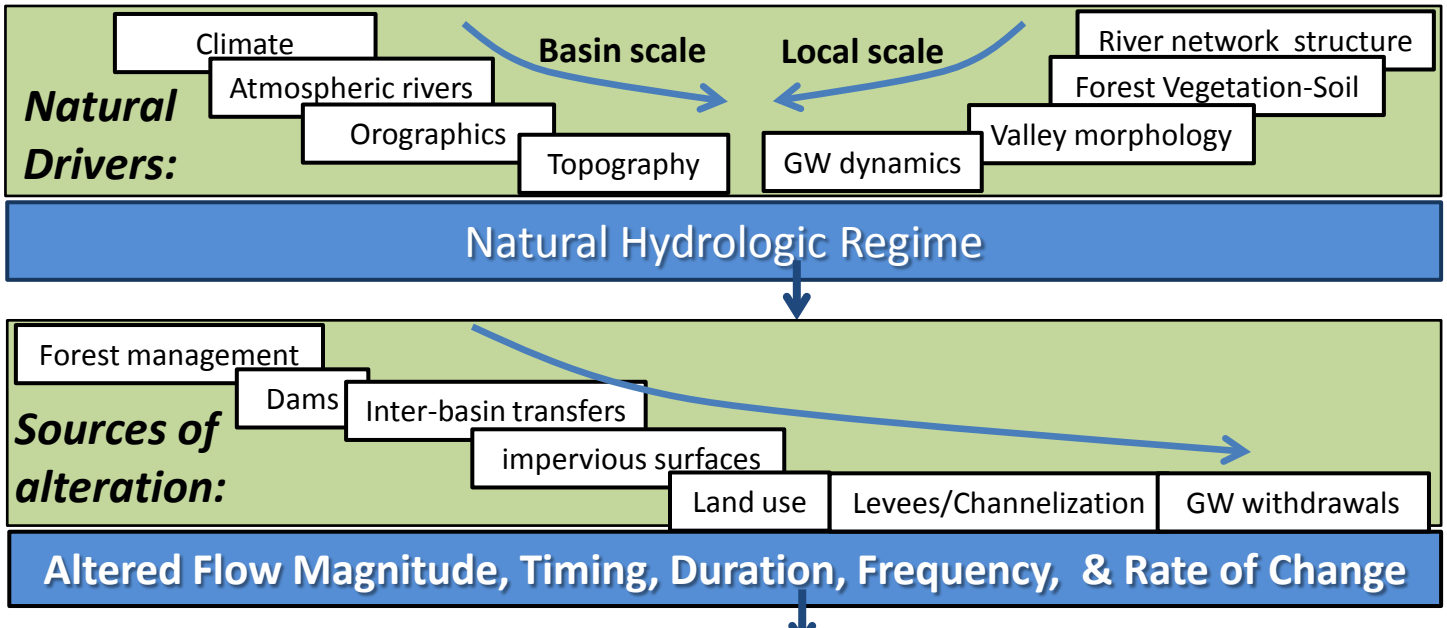
Cascade of responses to altered flow

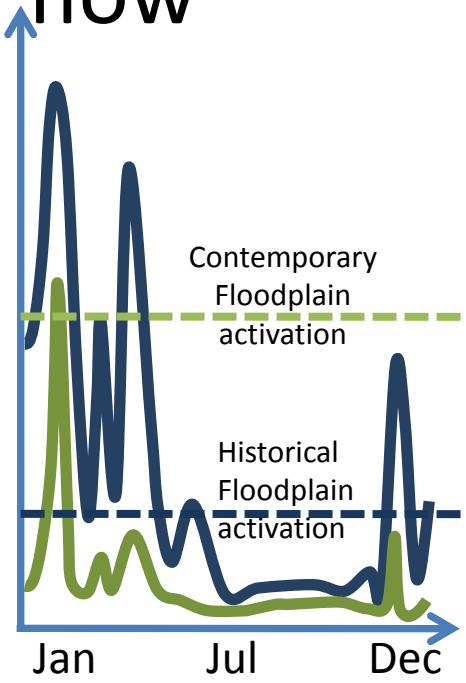






Cascade of responses to altered flow





Cascade of responses to altered flow

Natural Drivers:

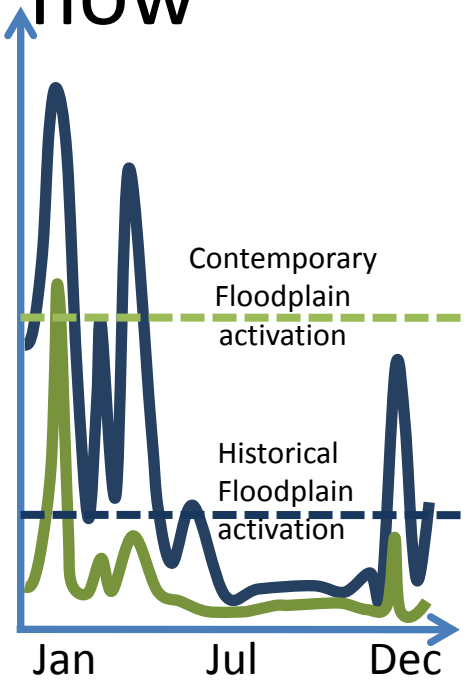
- Climate
- Atmospheric rivers
- Orographics
- Topography
- **Basin scale**
- **Local scale**
- River network structure
- Forest Vegetation-Soil
- Valley morphology
- GW dynamics

Natural Hydrologic Regime

Sources of alteration:

- Forest management
- Dams
- Inter-basin transfers
- impervious surfaces
- Land use
- Levees/Channelization
- GW withdrawals

Altered Flow Magnitude, Timing, Duration, Frequency, & Rate of Change



Proximate Stressors:

Δ Water Quality

- Sediment & turbidity
- Salinity, DO & temperature
- Nutrients & toxics

Δ Aquatic Habitat

- Depth, width, slope, & sinuosity
- Substrate texture
- Current structure
- Land/water interface
- LSZ location

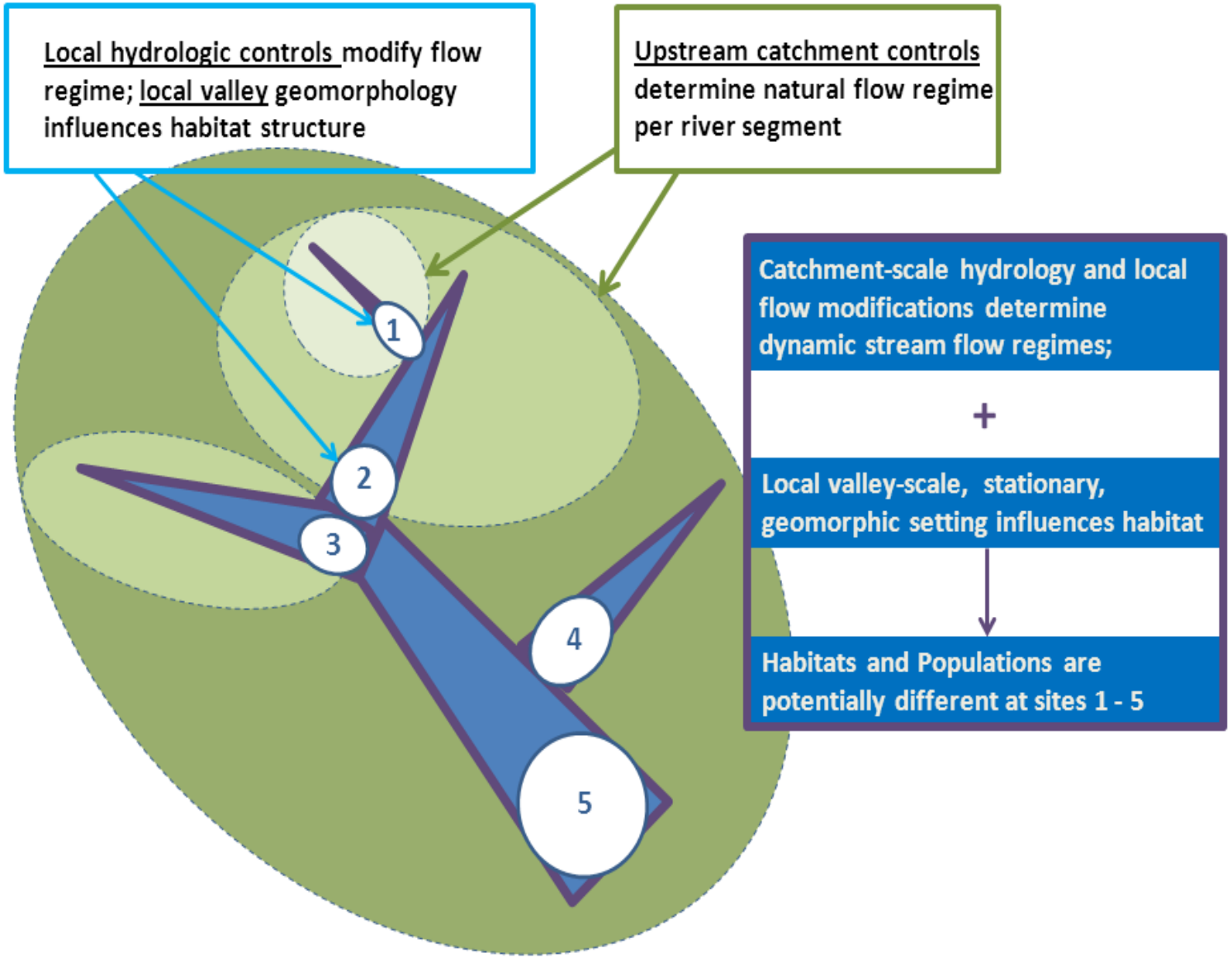
Degraded Habitat

Biological Response:

- Reproductive success & timing
- Food availability
- Competition & predation
- Physiology & behavior

Impaired Growth, Reproduction, and Survival of Native Populations

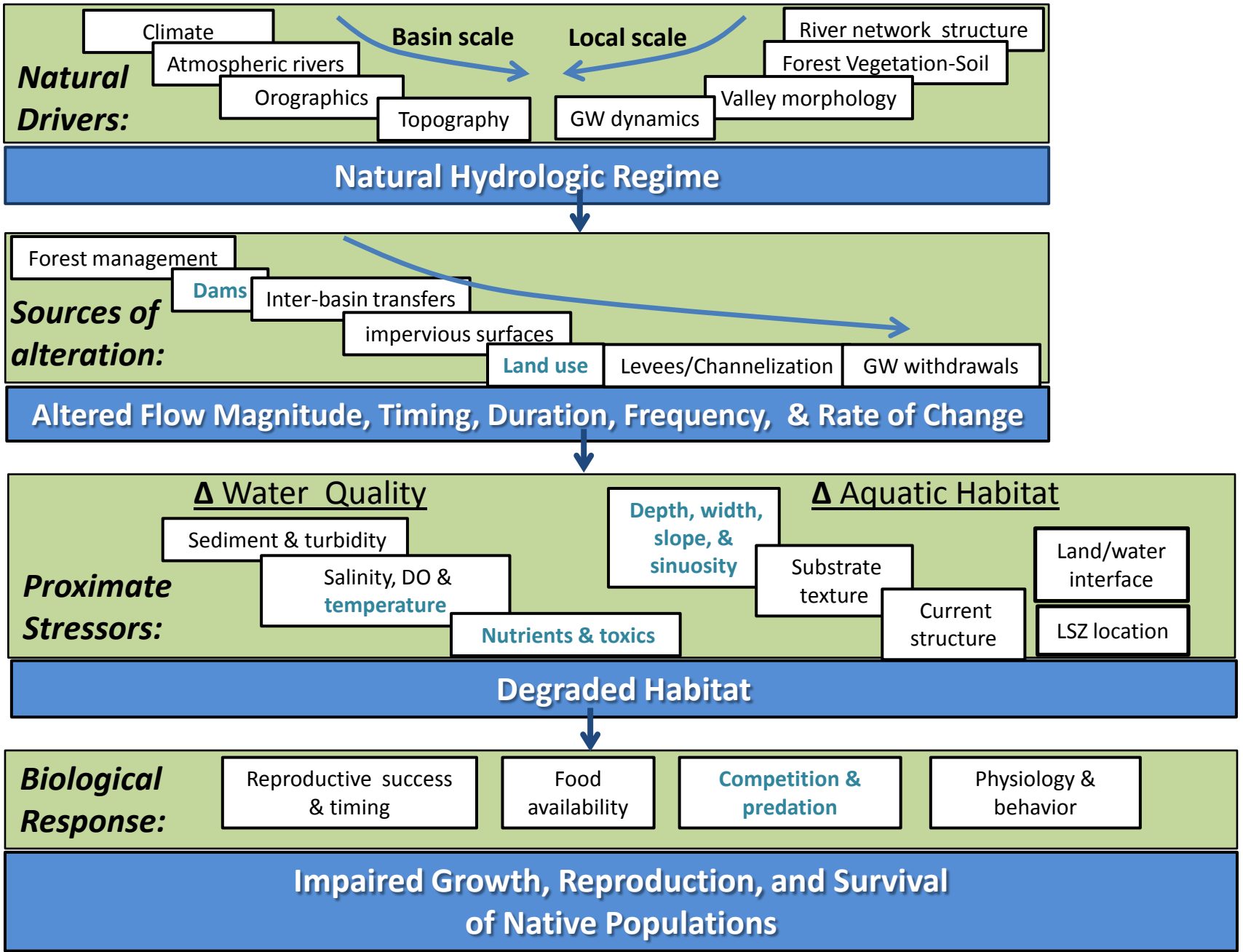
Hydrologic processes, flow regime, and resulting ecological characteristics are unique per stream segment.



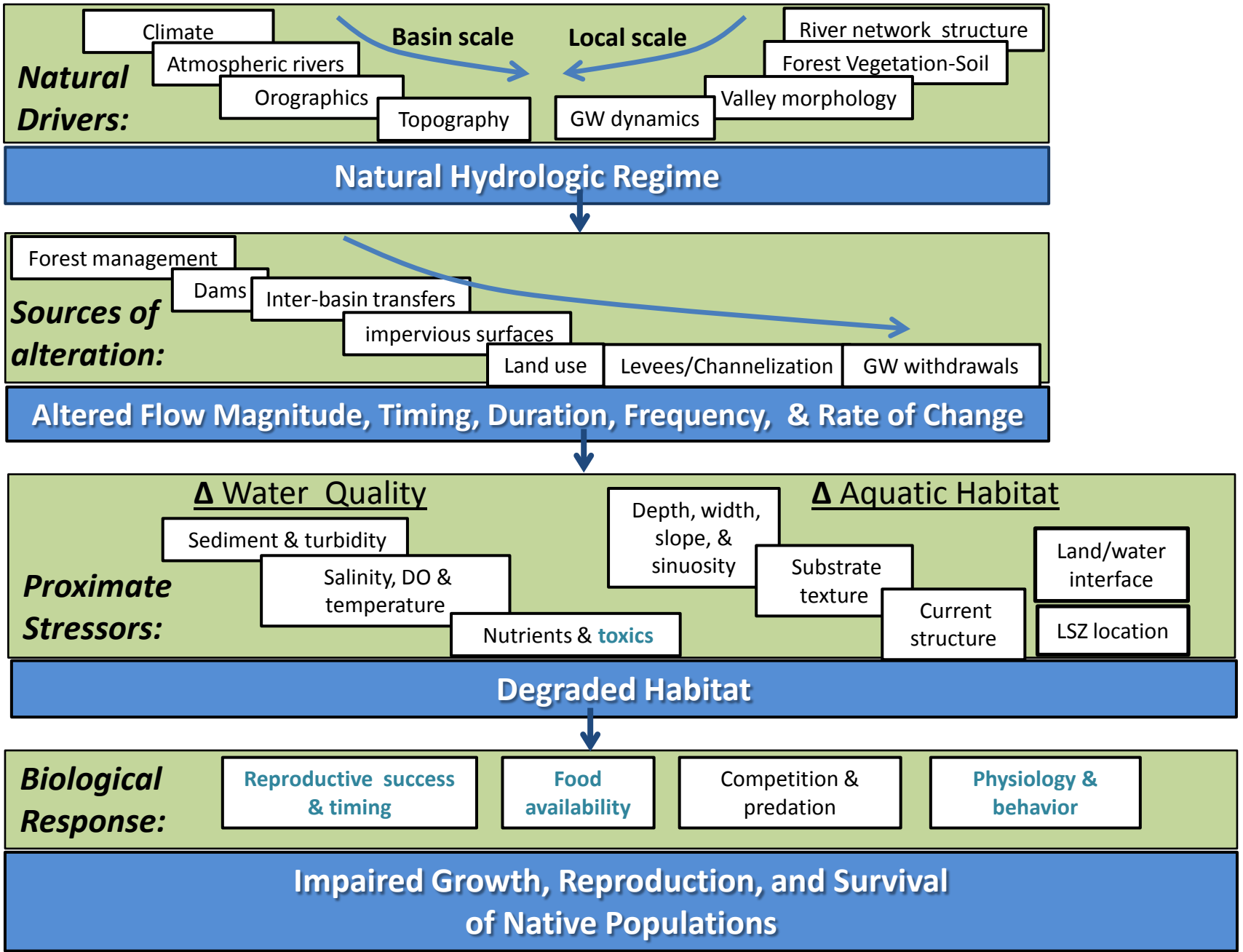
123°30'0"W
123°0'0"W
122°30'0"W
122°0'0"W
121°30'0"W
121°0'0"W
120°30'0"W
41°0'0"N
40°30'0"N
40°0'0"N
39°30'0"N
39°0'0"N
38°30'0"N
38°0'0"N
37°30'0"N
Klamath Mountains
McCloud River
Stony Creek
Sierra Nevada Mountains
Feather River
Sacramento River
Sacramento
Stockton
Oakland
San Francisco
Fremont
Copyright © 2011 National Geographic Society, i-cubed
0 10 20 40 60 80 100
km
0 10 20 40 60 80 100
Miles
N
GCS NAD83

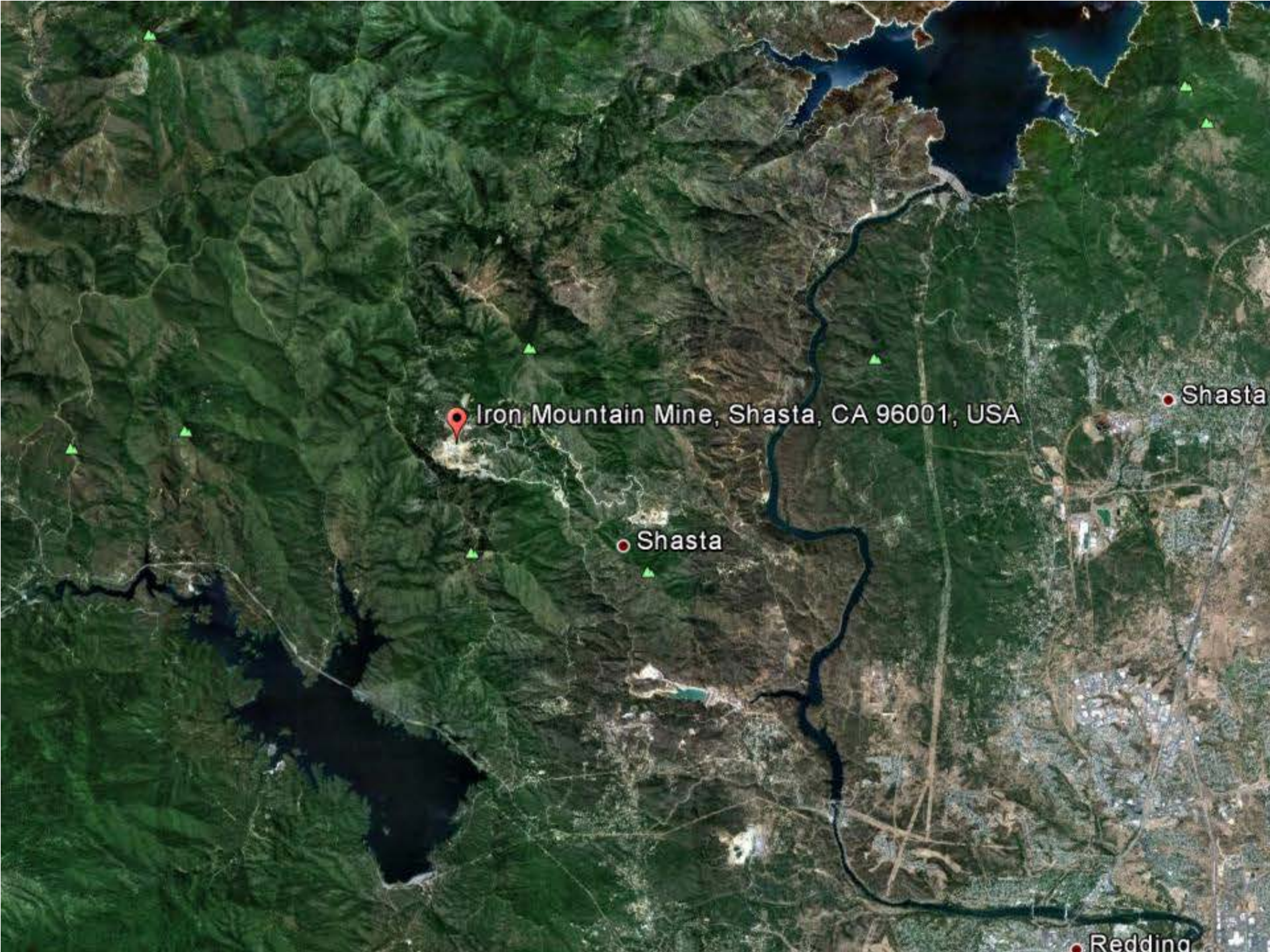
Black Butte Lake, California, USA
Black Butte Lake

Cascade of responses to altered flow

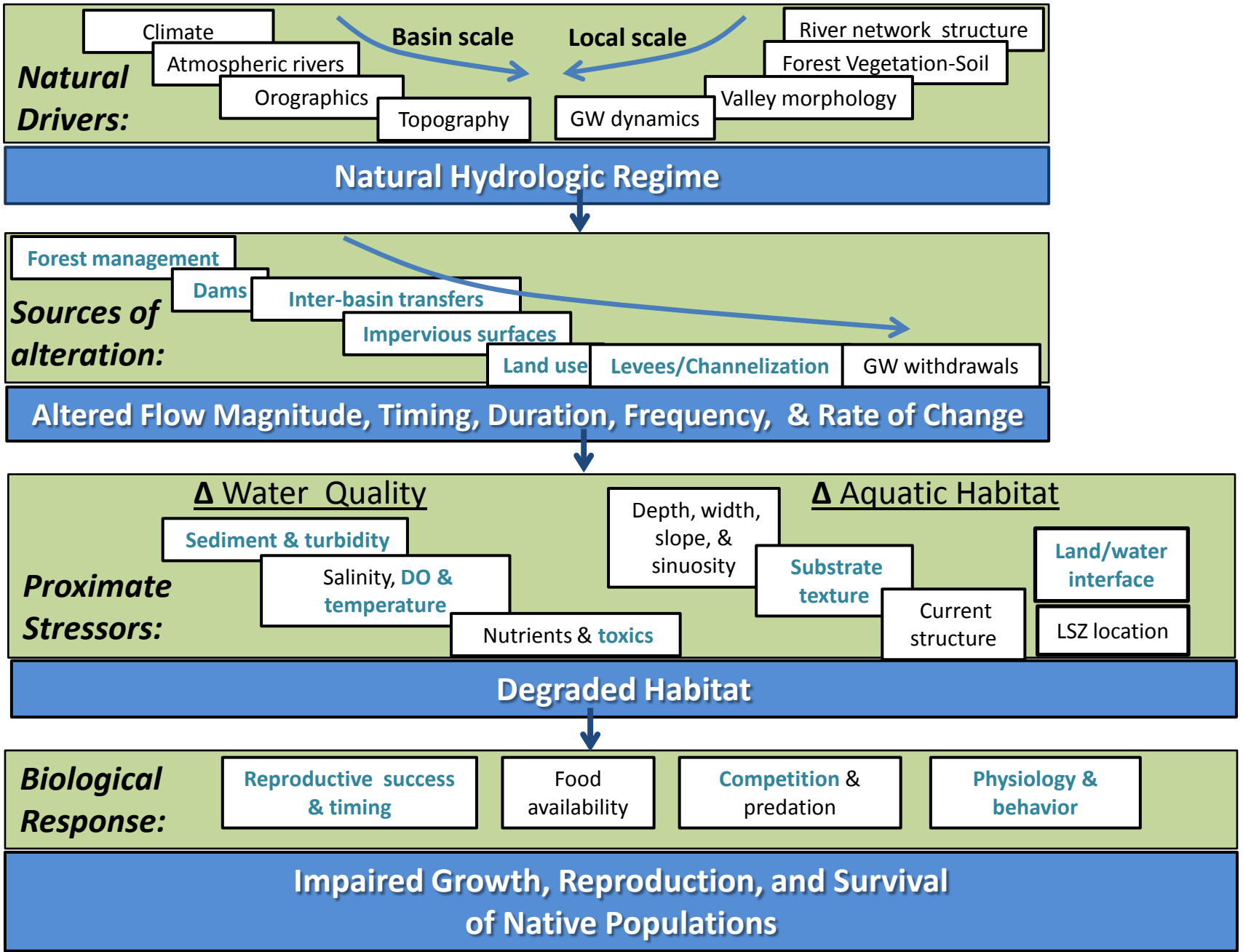


Cascade of responses to altered flow




Iron Mountain Mine, Shasta, CA 96001, USA
Shasta
Shasta
Redding

Cascade of responses to altered flow



1873 Delta:

Long residence time

Marsh connections

Two rivers connect to bay

Waterways dendritic

Modern delta

Short residence times

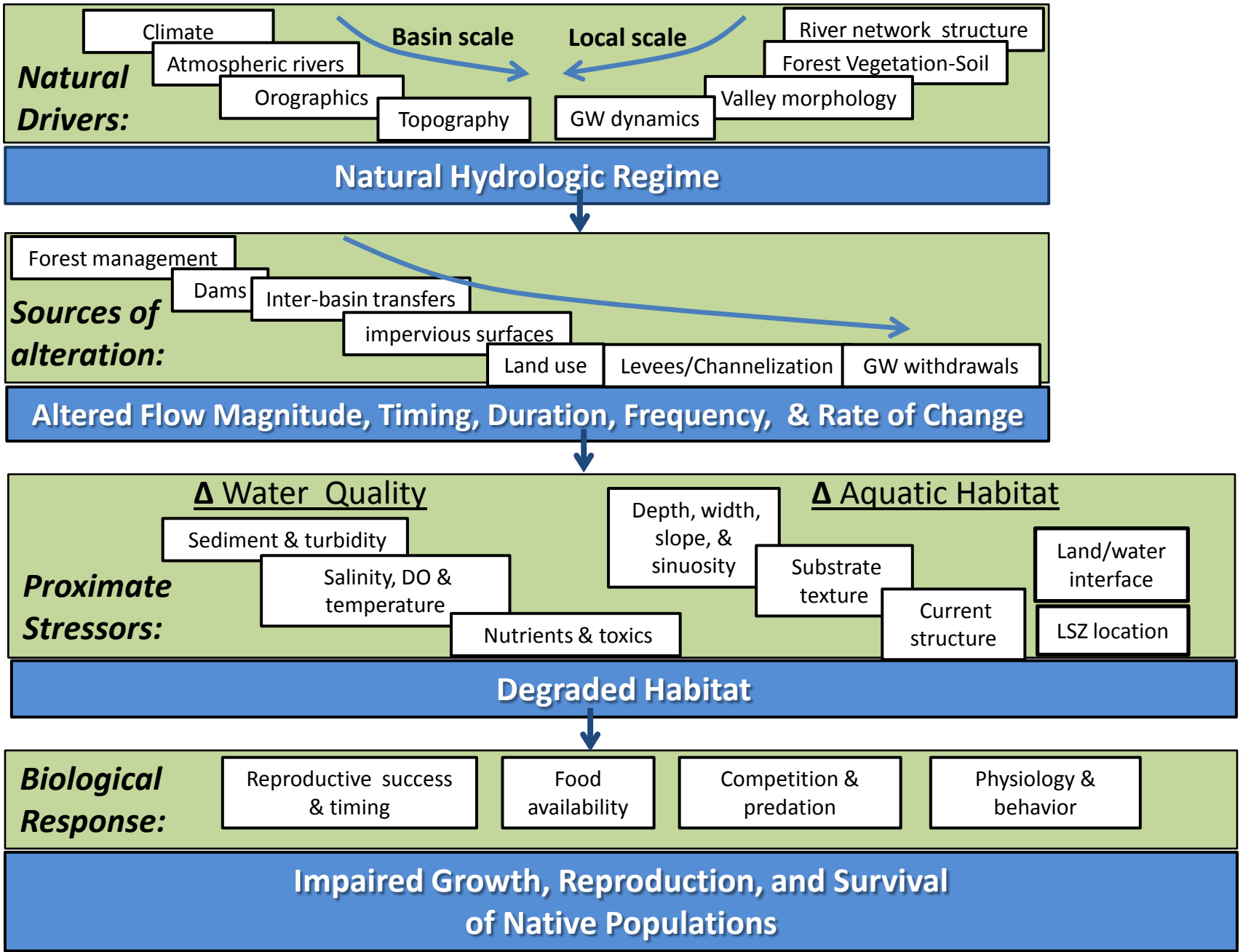
Rip-rapped

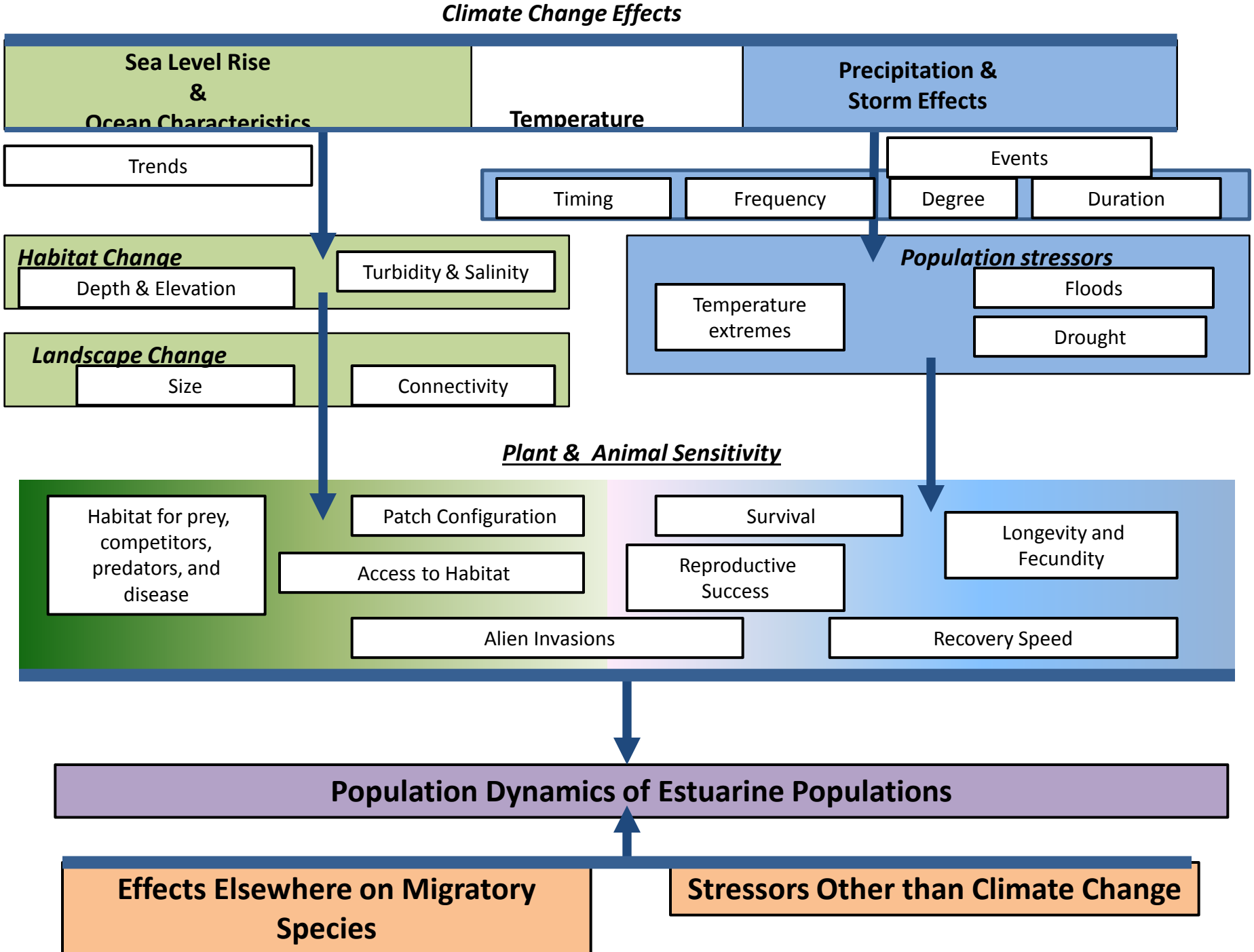
Cross Delta flows

Rare San Joaquin connection to bay

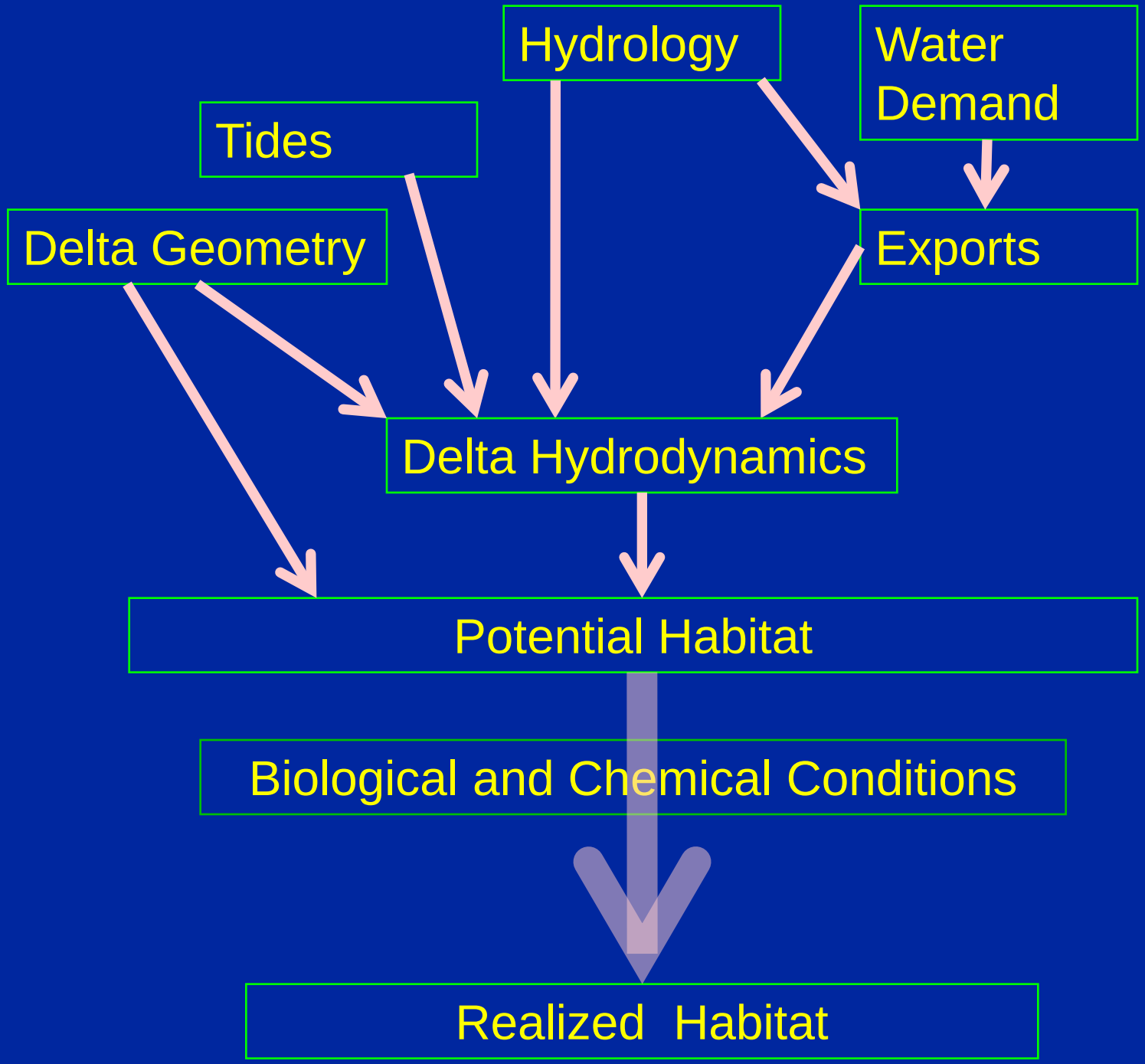
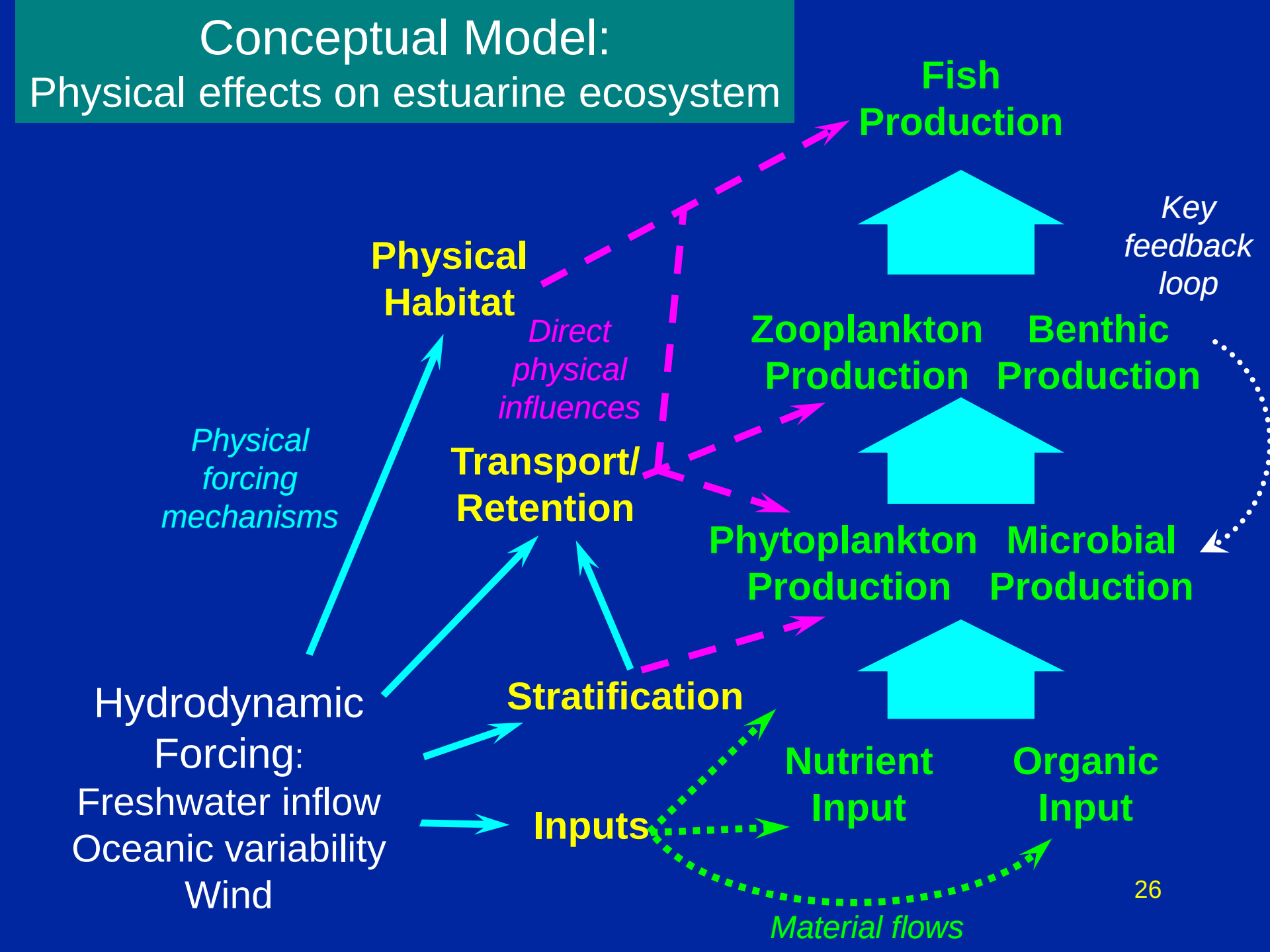
Waterways web-like

Cascade of responses to altered flow




Climate Change Effects
Sea Level Rise
&
Ocean Characteristics
Temperature
Precipitation &
Storm Effects
Trends
Events
Timing
Frequency
Degree
Duration
Habitat Change
Depth & Elevation
Turbidity & Salinity
Population stressors
Temperature
extremes
Floods
Drought
Landscape Change
Size
Connectivity
Plant & Animal Sensitivity
Habitat for prey,
competitors,
predators, and
disease
Patch Configuration
Access to Habitat
Survival
Reproductive
Success
Longevity and
Fecundity
Alien Invasions
Recovery Speed
Population Dynamics of Estuarine Populations
Effects Elsewhere on Migratory
Species
Stressors Other than Climate Change

How much water do fish need?


Hydrology
Water Demand
Tides
Delta Geometry
Exports
Delta Hydrodynamics
Potential Habitat
Biological and Chemical Conditions
Realized Habitat

Conceptual Model:
Physical effects on estuarine ecosystem